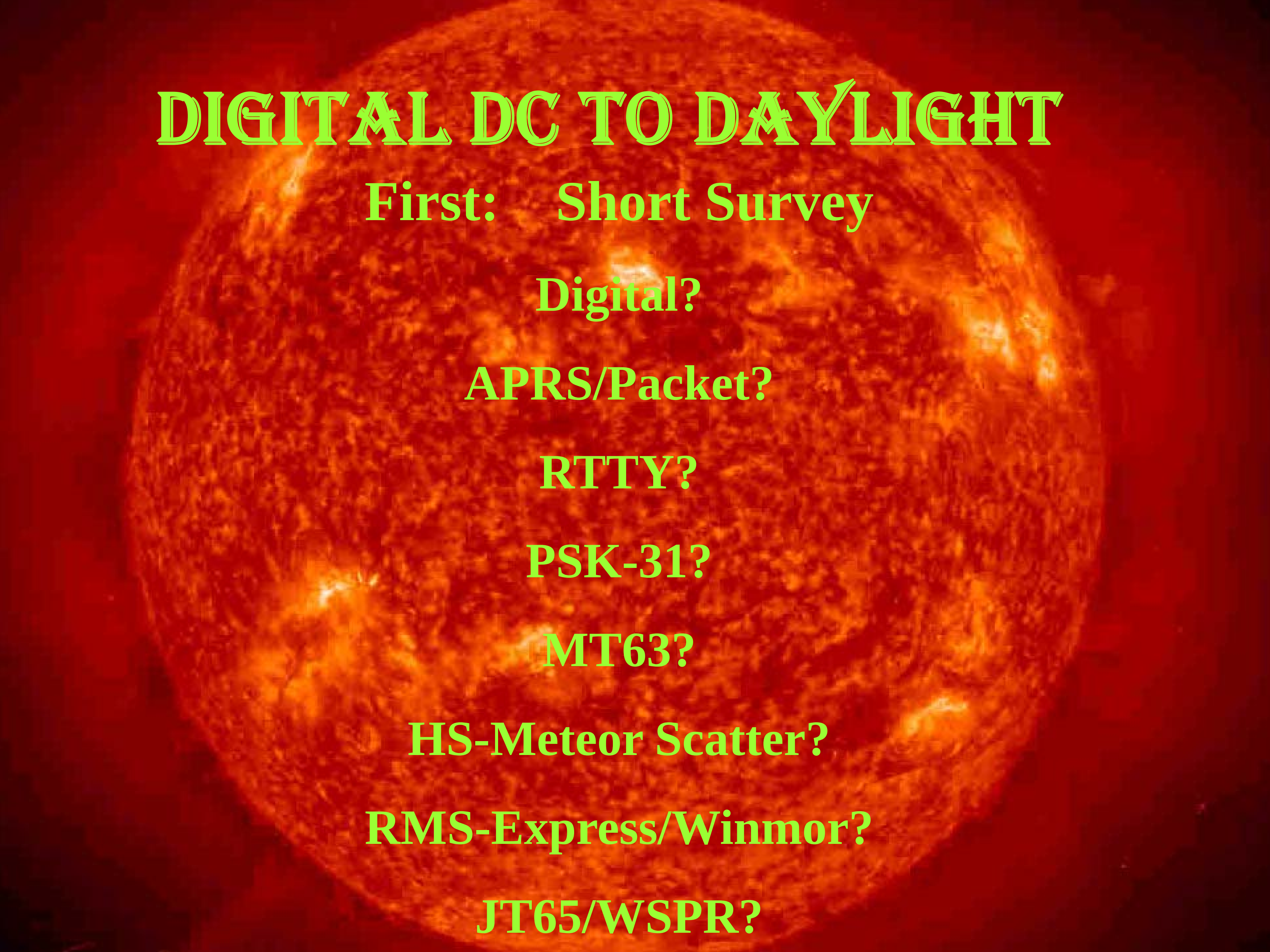
DIGITAL DC TO DAYLIGHT

2011 Communications Academy

Digital Track - Talk 1

How Digital Can Enhance Your Capability and Why it Belongs in Your Emergency Communications Toolkit

Curt Black – WR5J
Ken Iverson – AB7X
Jeff Coleman – W7EIR



DIGITAL DC TO DAYLIGHT

First: Short Survey

Digital?

APRS/Packet?

RTTY?

PSK-31?

MT63?

HS-Meteor Scatter?

RMS-Express/Winmor?

JT65/WSPR?

W7AW West Seattle Amateur Radio Club
AB7X
West Seattle Amateur Radio Club
Ken AB7X
Canon
SAMSUNG

OVERVIEW

Why Digital?

What is Digital?

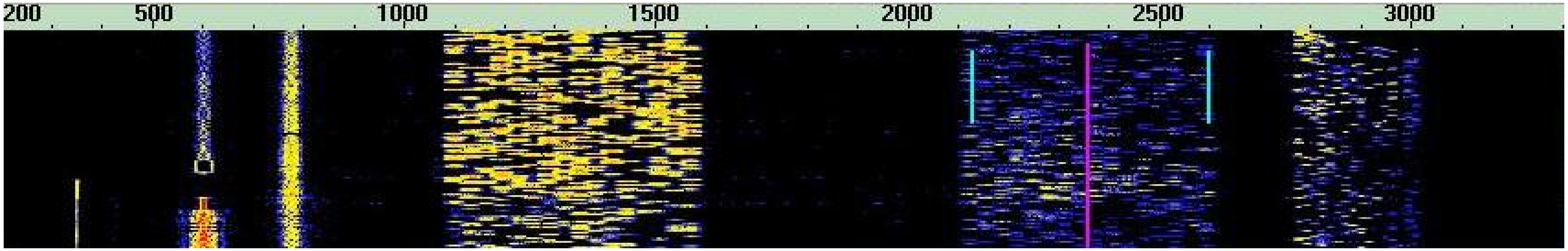
Can Digital Out-Perform Voice?

How Do I Learn More and Practice?

With Demonstrations Throughout

& Questions Anytime!

Why Use Digital Modes?



PSK31 Olivia 500Hz/ 16 tones Olivia 500Hz/ 16 tones MFSK16

- **WE NEED THE HELP – The Future Looks Bad Here!!!**
- **Low Power – 10-20dB improvement over voice**
- **Spectrum efficiency – many conversations in bandwidth of one SSB QSO**
- **Great for reliable Communications – HF – VHF - UHF**
- **Many modes - choose your mode depending on conditions**
- **Emergency Communications – 100% integrity on complex messages – sent from One-to-Many – with low power or temporary antennas**
- **It's FUN – Use it in your daily practice so proficiency is high**
- **Bottom of the solar cycle - works well, even under very poor conditions where phone QSO's would be impossible!**
- **Perfect for a modern ham trapped in Urban Apartment land**

EMERGENCY
WHEN ALL ELSE FAILS!
Ham Radio Works!
SKYWARN
COMMUNICATIONS

AMATEUR RADIO
A R R L
EMERGENCY SERVICE

WHEN ALL ELSE FAILS...
A R R L
AMATEUR RADIO
146.550

Amateur Radio Emergency
ARECC
Communications Course

Disclaimer 1 of 2:

I don’t want to change the way you do everything.

I don’t want a complex bunch of infrastructure that is hard to learn and worse to use.

I don’t want us to depend on any one piece of our tool kit for the indispensable services we provide.

I DO want us to leverage these simple, free digital tools to enhance our capabilities.

(And I want us to practice and practice so it is second nature to use these when it is appropriate)

Disclaimer 2 of 2:

Windows Computers Frequently Make Me CRAZY

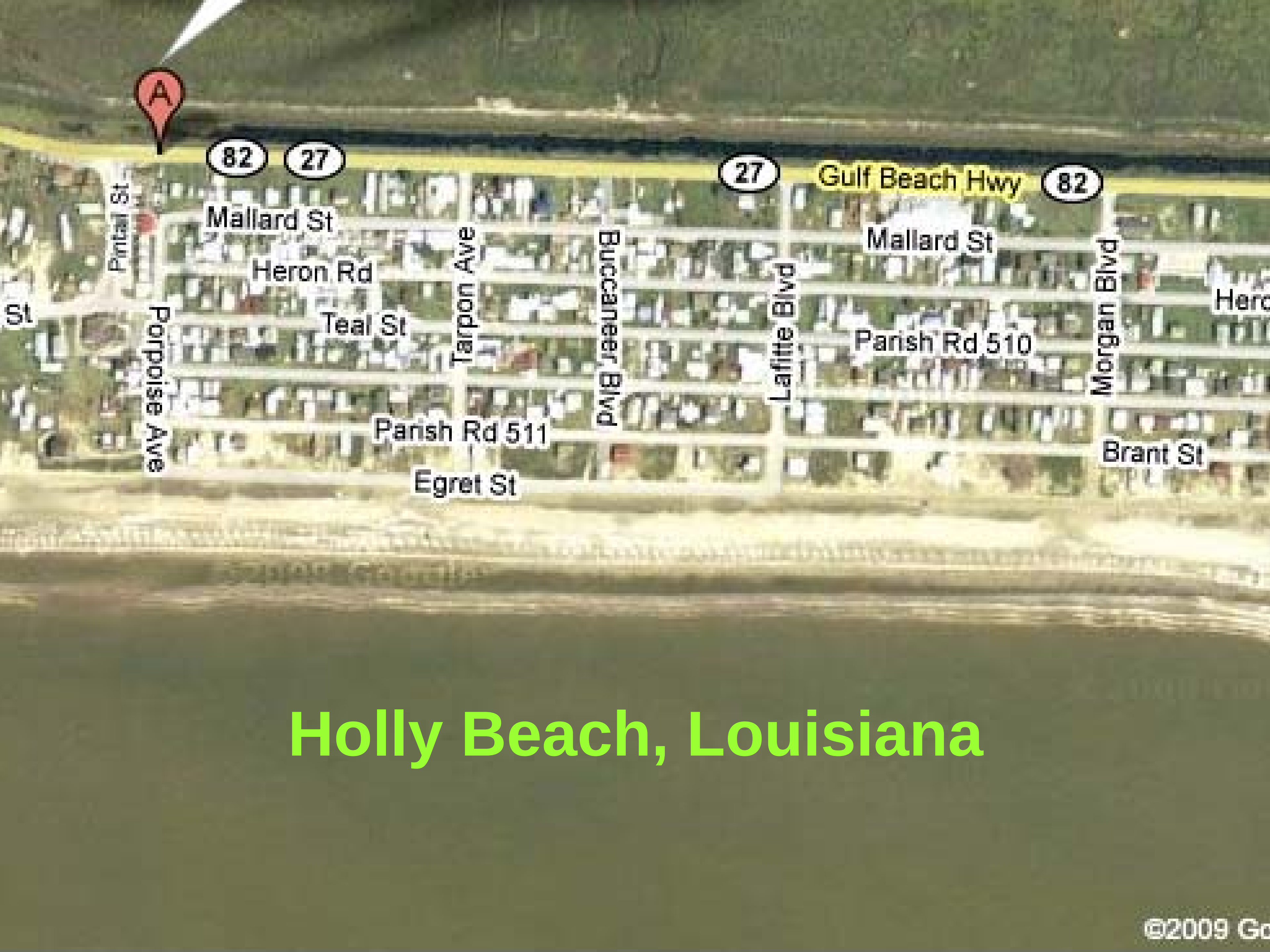
I absolutely do not trust them to work.

I feel your pain.

I’m not proud of it, but I have physically abused miscreant computer hardware in the past.

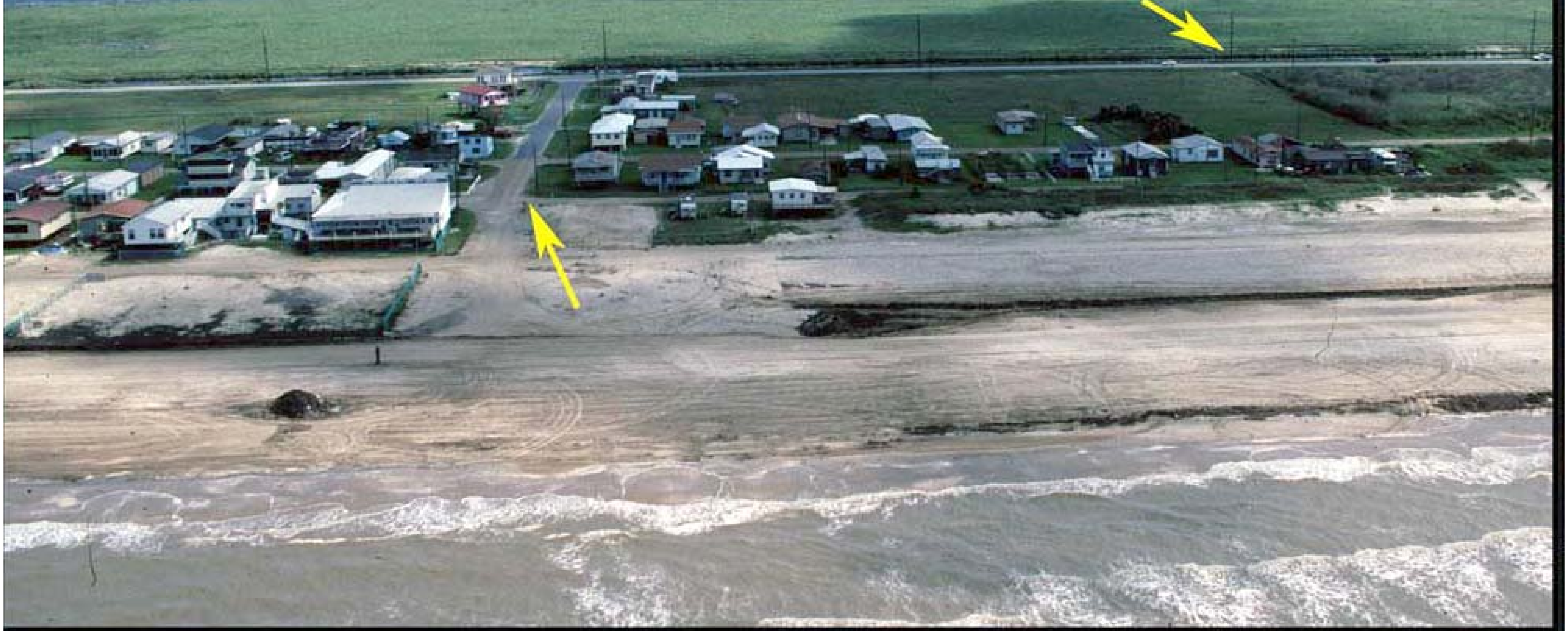
I don’t want us to depend on any one piece of our tool kit for the indispensable services we provide.

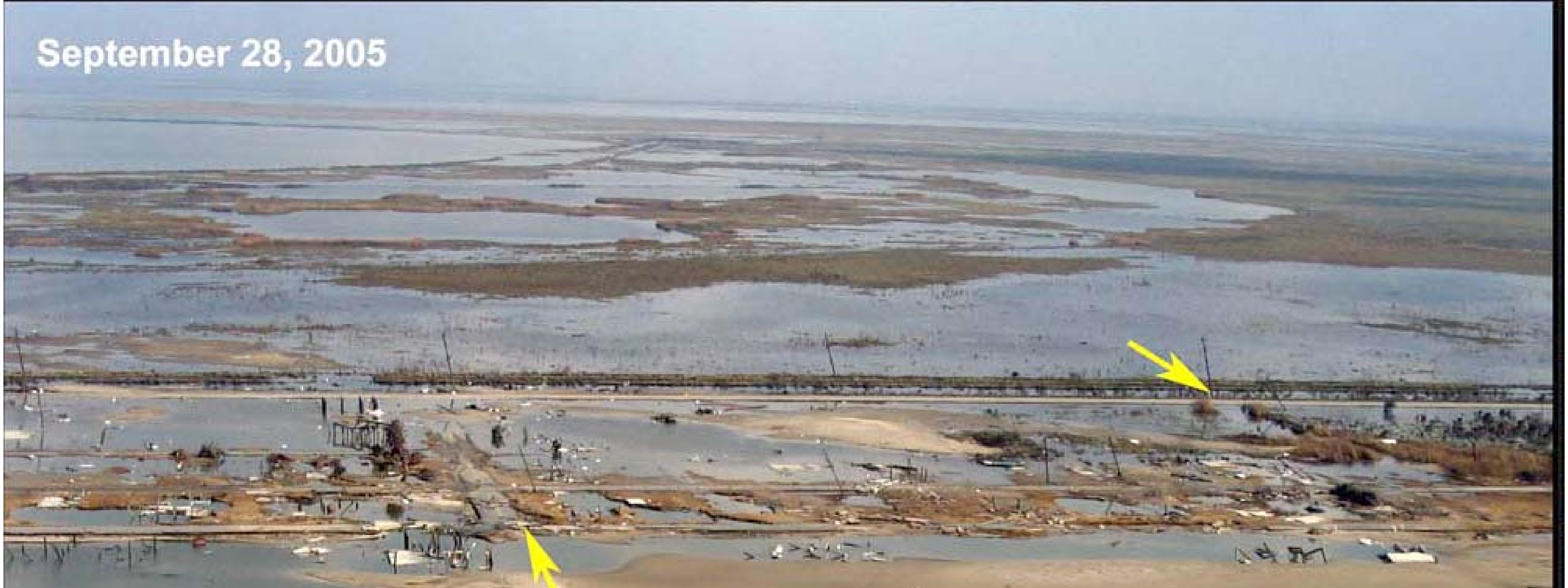
I don’t want us to depend on any one piece of our tool kit for the indispensable services we provide.



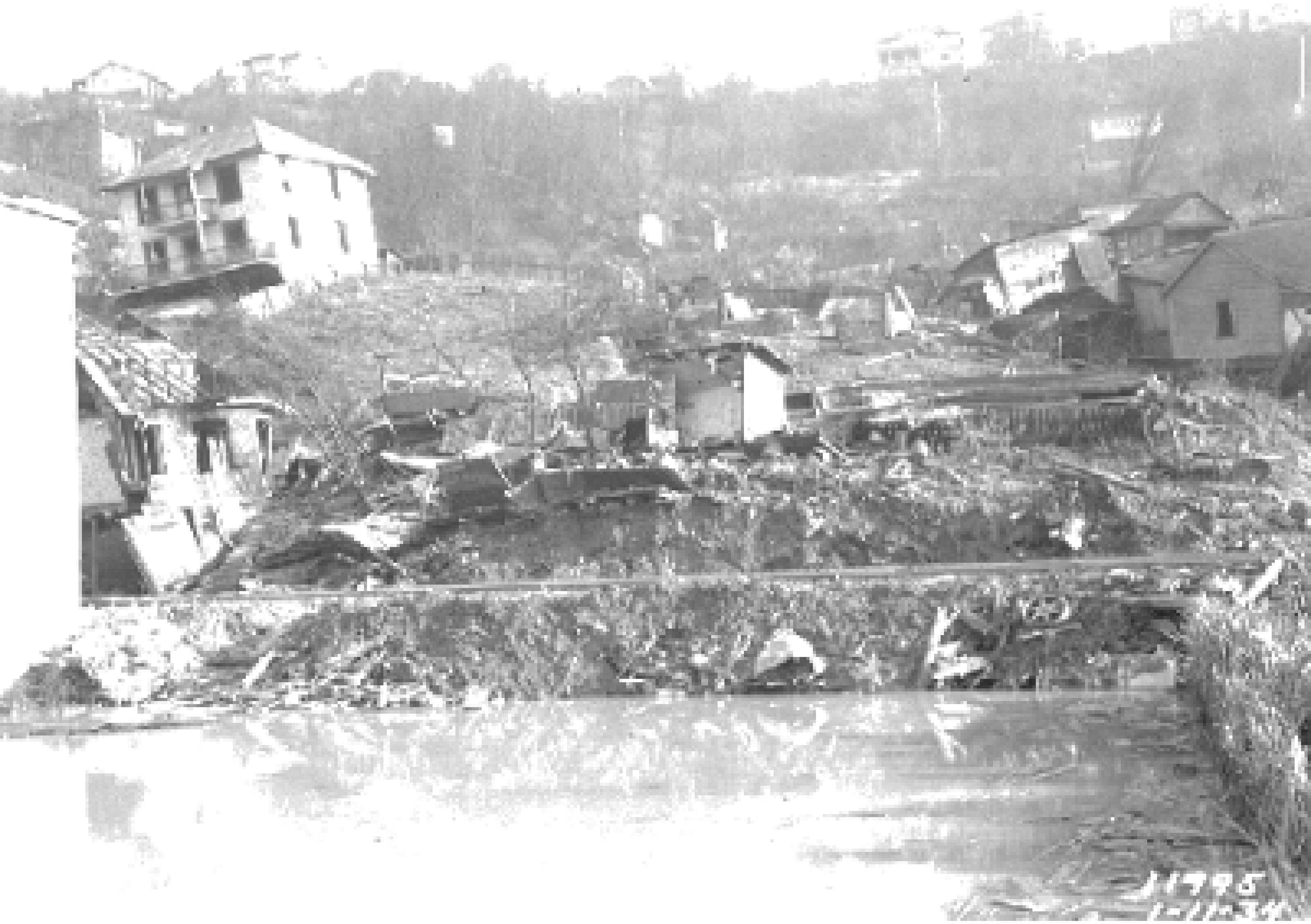
Holly Beach, Louisiana

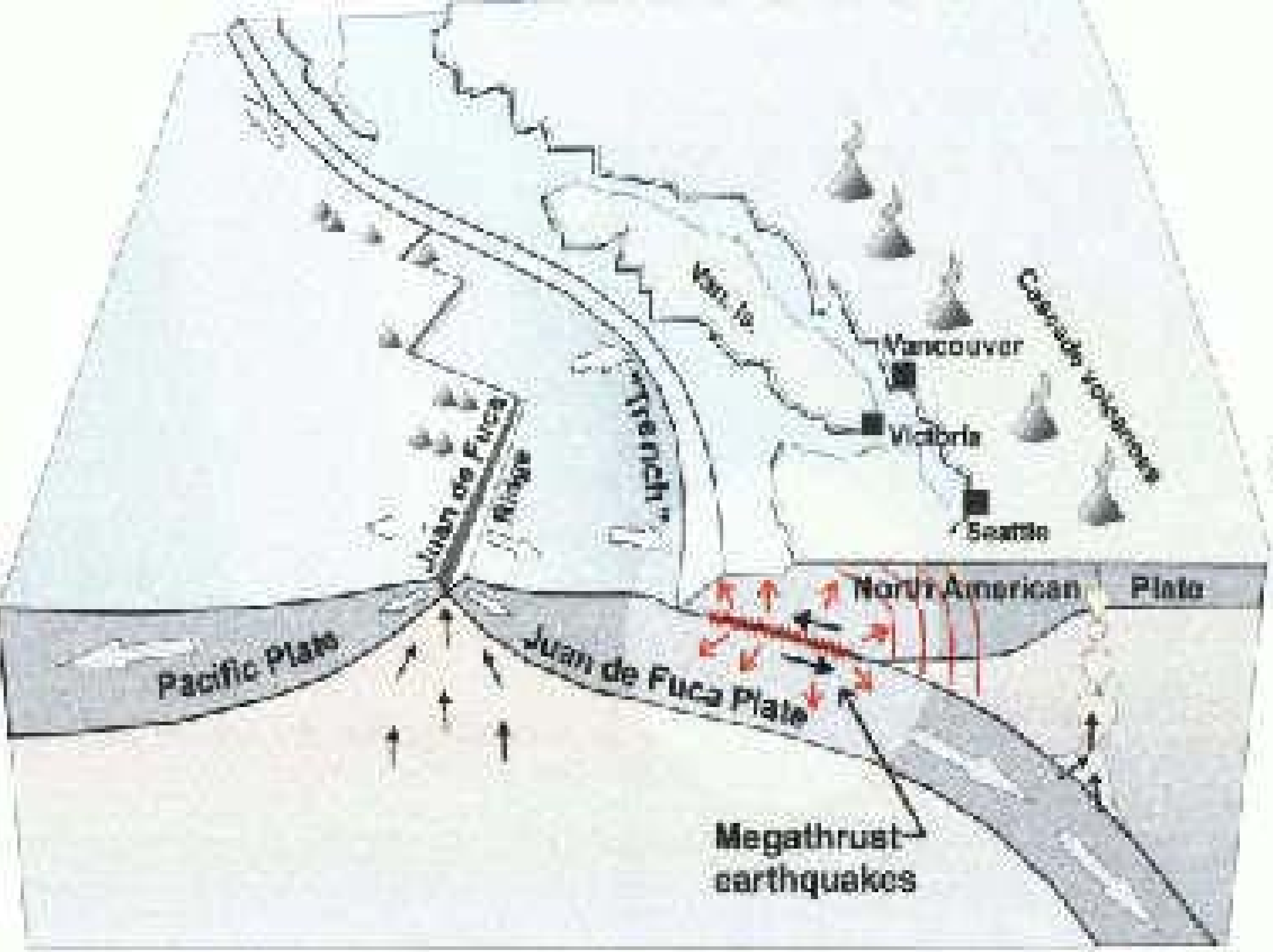
28N
28N
24N
24N

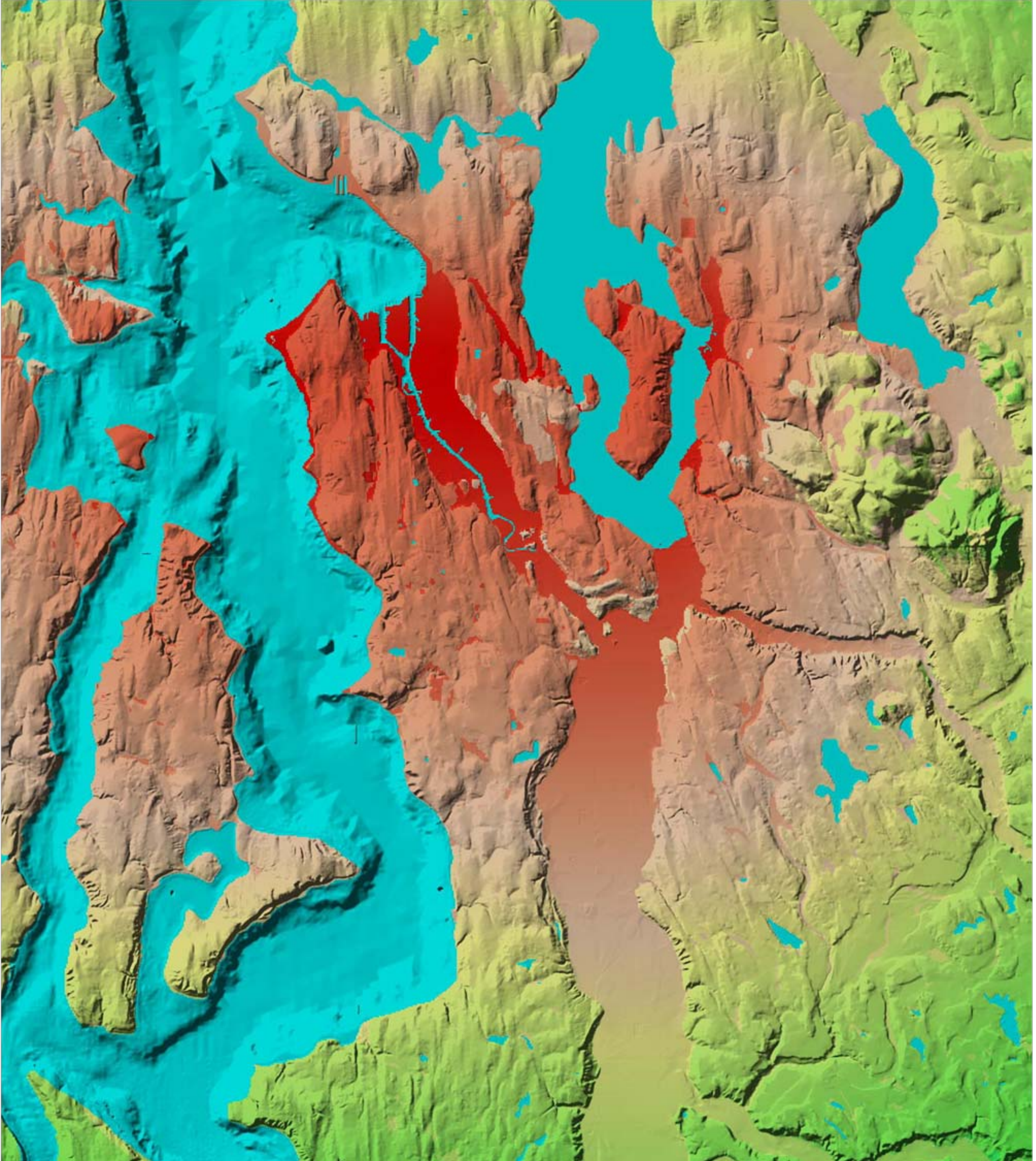




September 28, 2005


11795
1-11-34


Van. Is
Vancouver
Victoria
Seattle
Cascade volcanoes
"Trench"
Juan de Fuca Ridge
North American Plate
Pacific Plate
Juan de Fuca Plate
Megathrust earthquakes



Predicted Ground Acceleration due to a Seattle Fault Zone Earthquake

Red is not a good thing…

EXIT 168 A
Boylston Ave
Roanoke St
1 MILE
EXT. 168 B
EAST
SOUTH
5
Bellevue
Kirkland

recall
www.recall.com
recall
recall

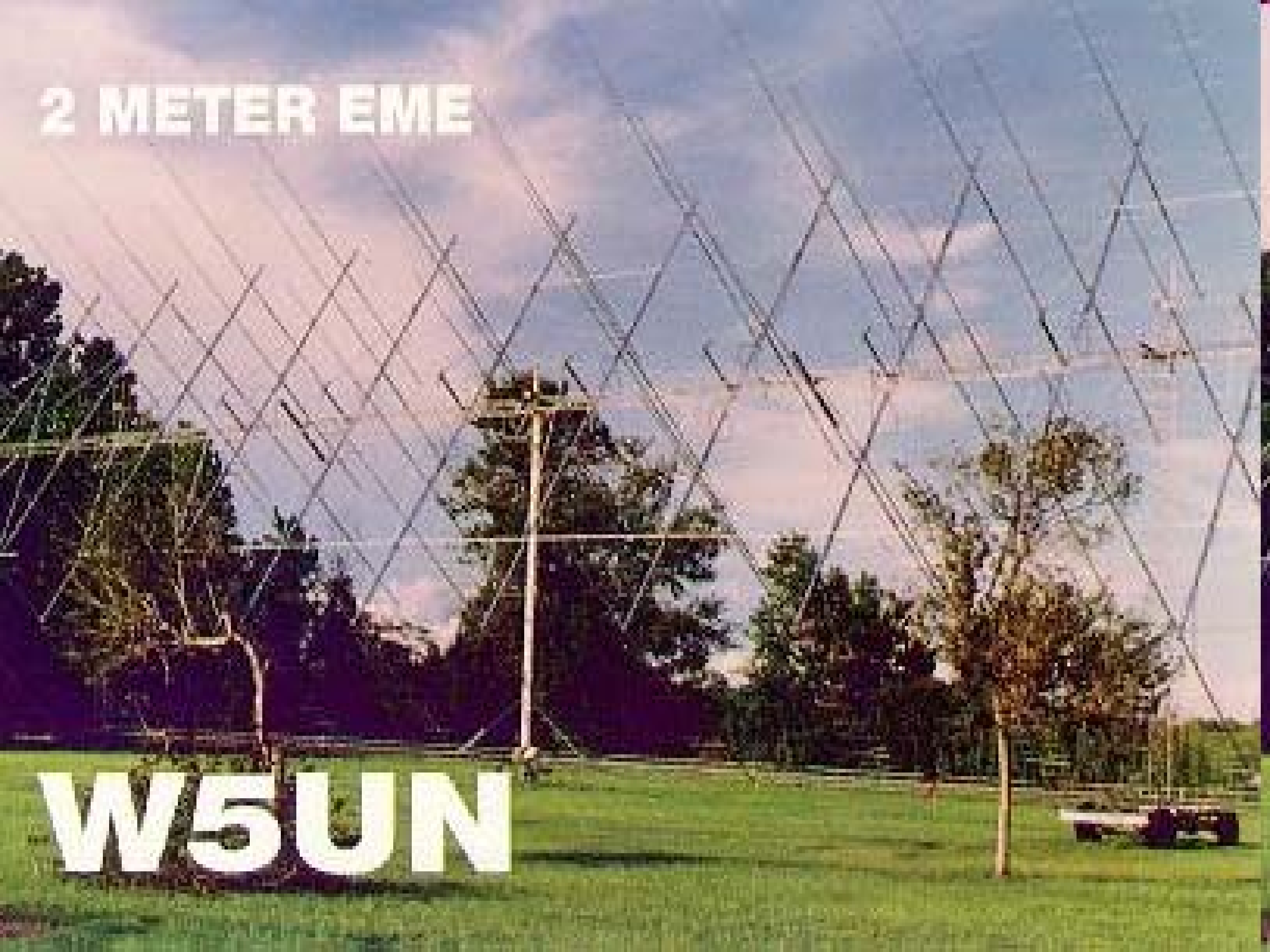
HANJIN
YANG MING

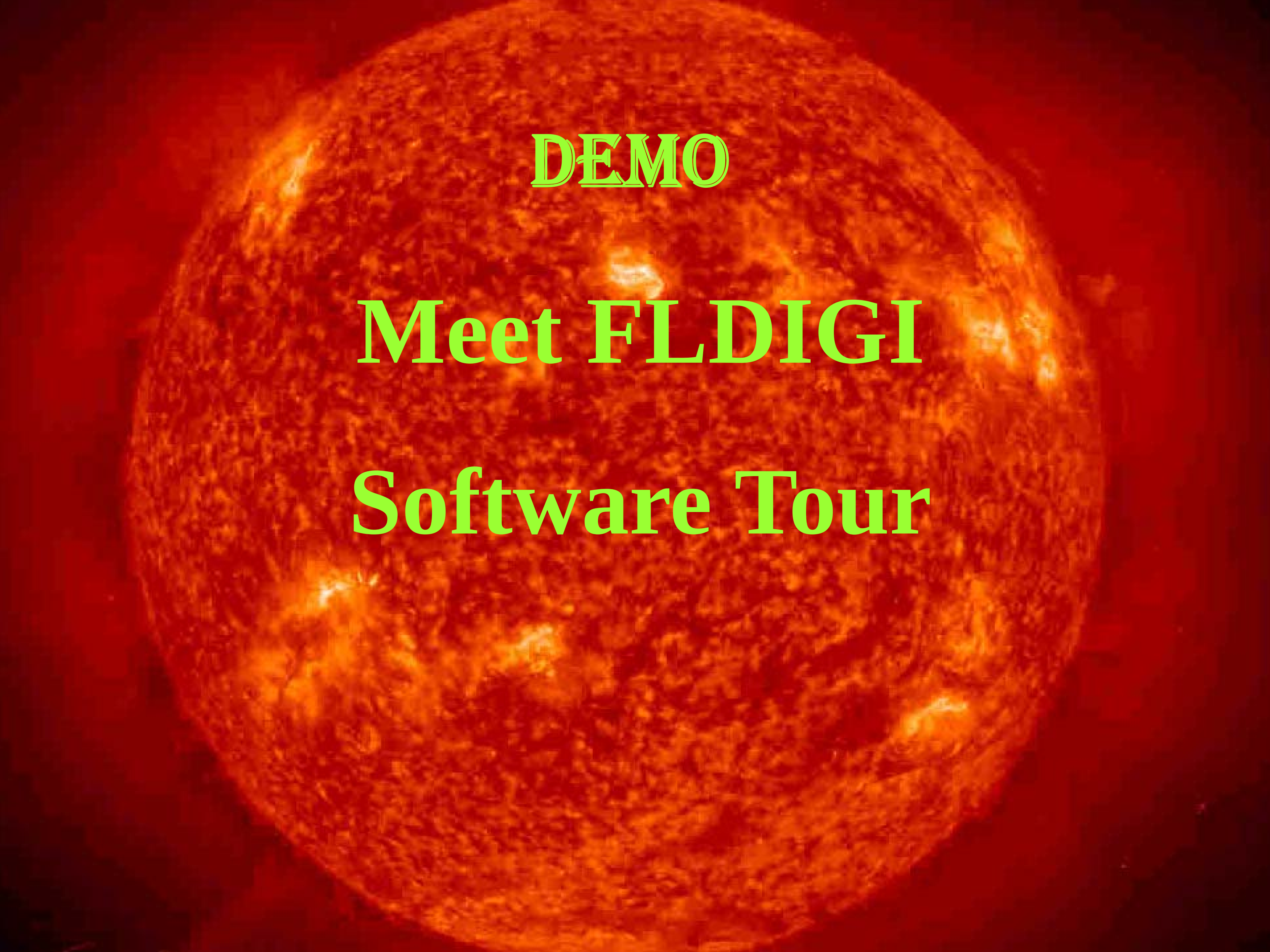
RED LIGHT
PHOTO
ENFORCED
AHEAD
HOTEL
VINTAGE PARK

You don’t need “Aluminum Sky” for these modes – weak signals are “almost better”

Ian,
VK3MO-
Melbourn

Mode	Seconds to Send Gettysburg Address	minimal S/N in dB
* SSB	120	9
Packet AX.25 1200Baud		8
Packet AX.25 300Baud		3
PSK-500	21	Approx 1
MT-63/2000	86	-2
Pactor 1 100 Baud		-4
** RTTY	301	-5.5
** Olivia 8/1000	256	-7
PSK63	139	-8
** Olivia 8/500	504	-11
**DominoEX22	98	-9
** Olivia8/500	504	-11
**DominoEX11	188	-11
**PSK31	317	-11
** MFSK16	247	-13
***Reed-Solomon ID		-16
****JT65A		-24


2 METER EME
W5UN



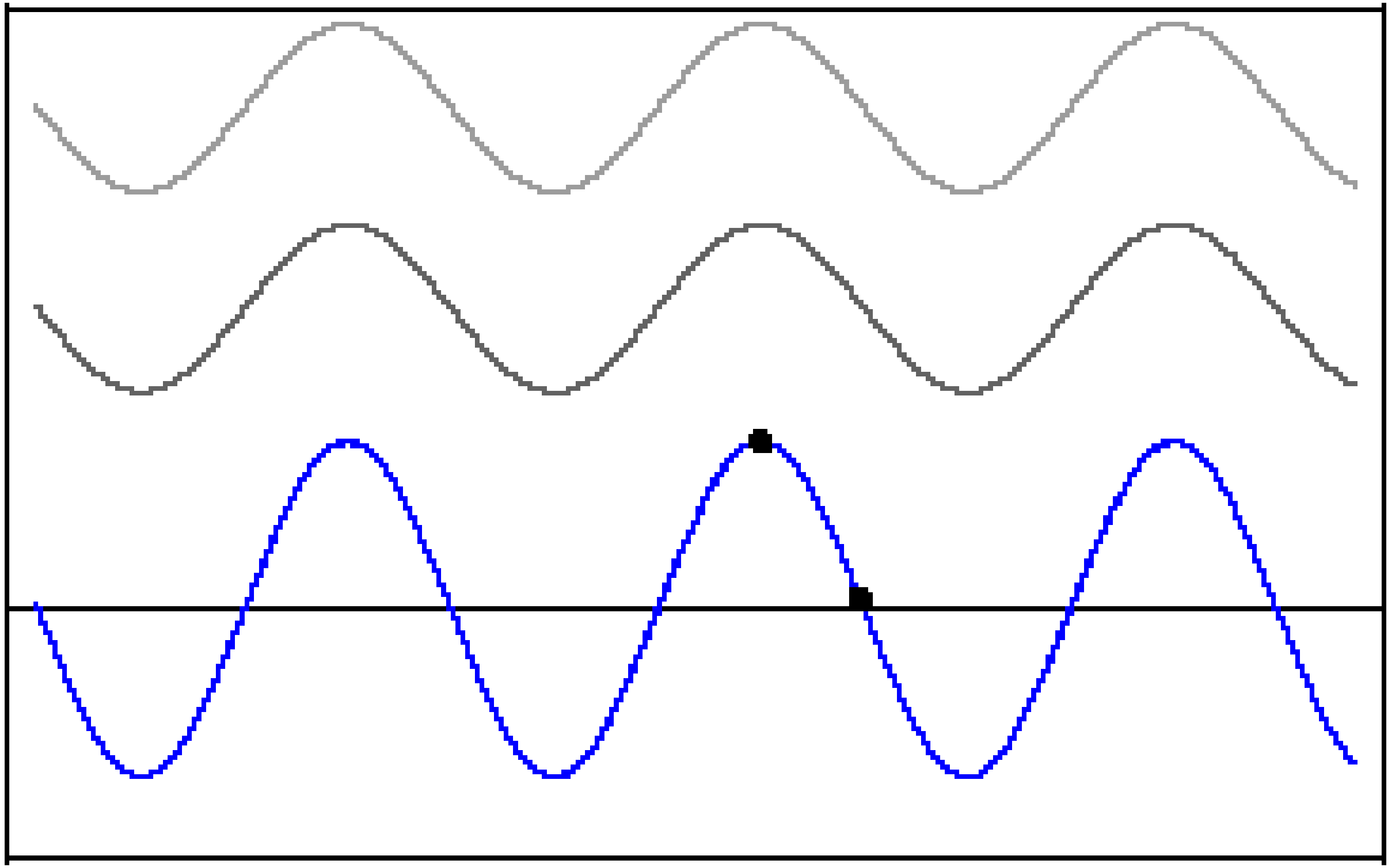
DEMO

Meet FLDIGI

Software Tour

Hardware

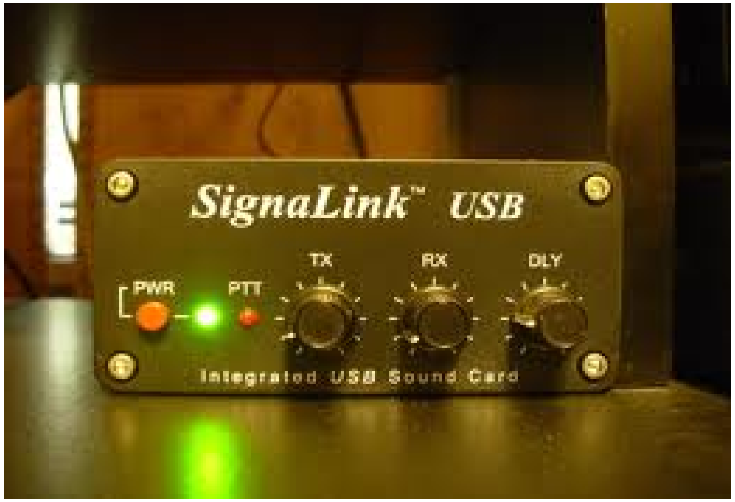
- **Inexpensive Computer**
- **HF or VHF/UHF Radio/Antenna**
- **Sound Card Interface?**
- **Or, maybe just the Mic built into your laptop?**



USB Sound Card Interface

- USB Sound Card connects your radio, provides RF isolation and automates the PTT when you transmit
- Built in sound card – quieter than internal hardware
- Interface uses only 2 cables – 1 to radio, 1USB to computer

$99

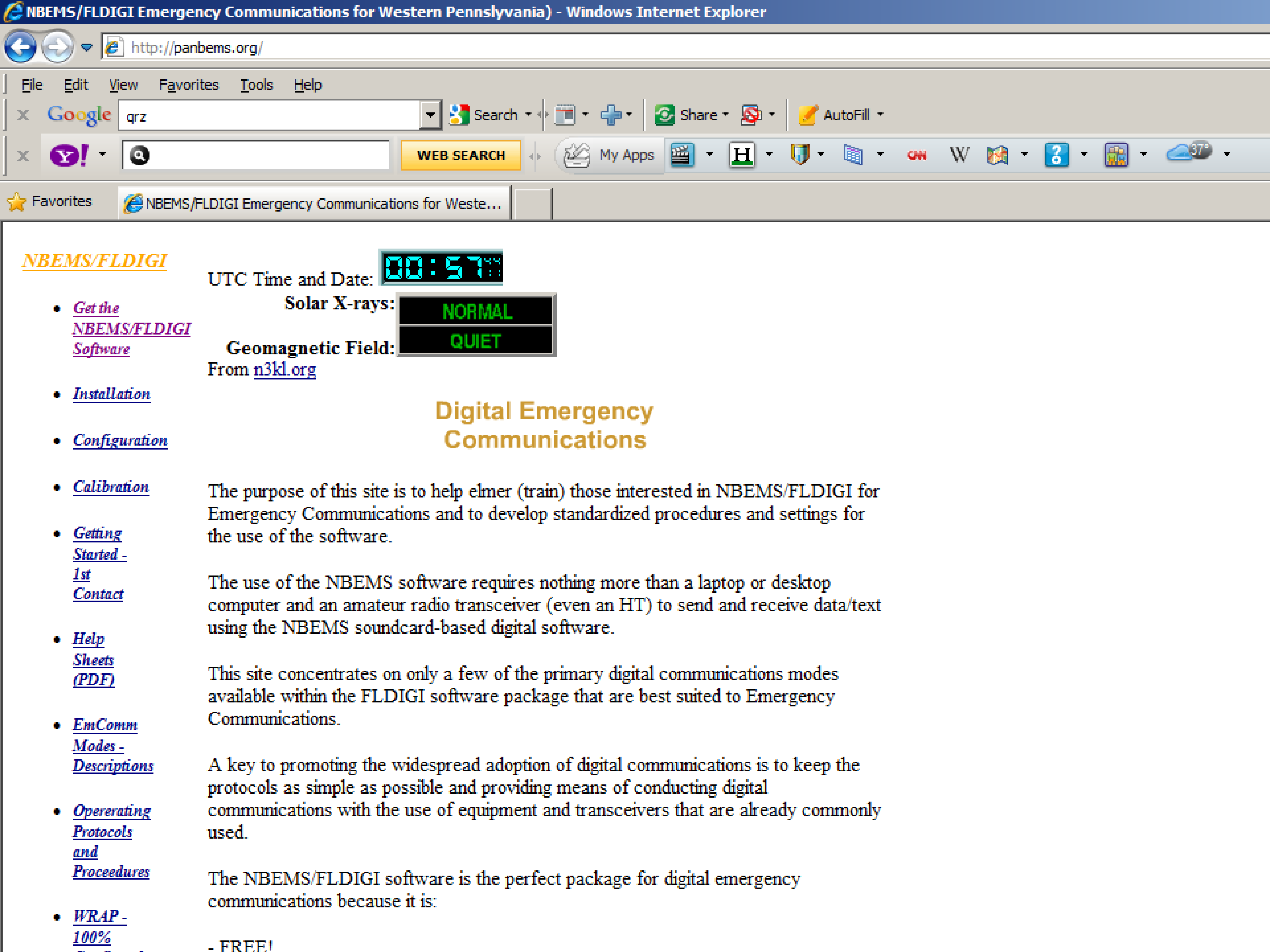


Excellent

value!

The SignaLink USB Sound Card has the advantage of

TX , RX *volume controls and Delay on the front panel*.


NBEMS/FLDIGI Emergency Communications for Western Pennslyvania) - Windows Internet Explorer
http://panbems.org/
File Edit View Favorites Tools Help
Google qrz Search Share AutoFill
WEB SEARCH My Apps
Favorites NBEMS/FLDIGI Emergency Communications for Weste...
00:57

NBEMS/FLDIGI

- *Get the NBEMS/FLDIGI Software*
- *Installation*
- *Configuration*
- *Calibration*
- *Getting Started - 1st Contact*
- *Help Sheets (PDF)*
- *EmComm Modes - Descriptions*
- *Opererating Protocols and Proceedures*
- *WRAP - 100%*

UTC Time and Date: 00:57

Solar X-rays: NORMAL

Geomagnetic Field: QUIET

From n3kl.org

Digital Emergency Communications

The purpose of this site is to help elmer (train) those interested in NBEMS/FLDIGI for Emergency Communications and to develop standardized procedures and settings for the use of the software.

The use of the NBEMS software requires nothing more than a laptop or desktop computer and an amateur radio transceiver (even an HT) to send and receive data/text using the NBEMS soundcard-based digital software.

This site concentrates on only a few of the primary digital communications modes available within the FLDIGI software package that are best suited to Emergency Communications.

A key to promoting the widespread adoption of digital communications is to keep the protocols as simple as possible and providing means of conducting digital communications with the use of equipment and transceivers that are already commonly used.

The NBEMS/FLDIGI software is the perfect package for digital emergency communications because it is:

- FREE!

Sound Card Calibration

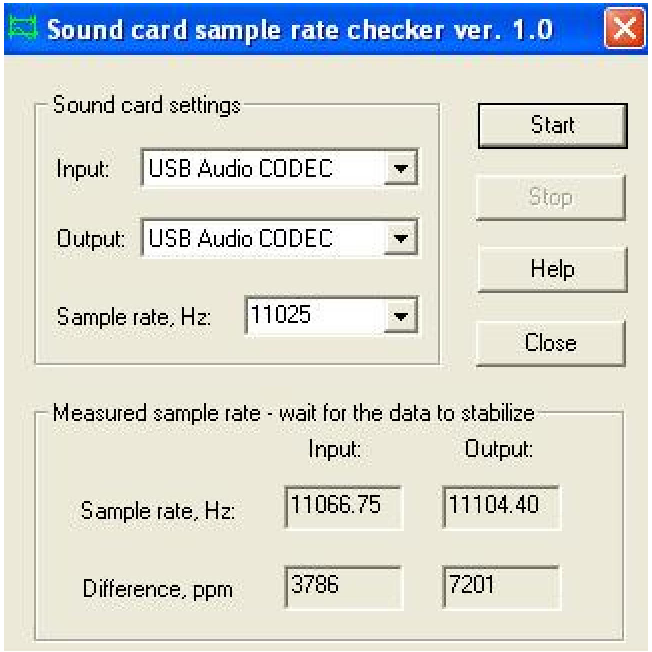
CheckSR

http://www.panbems/CheckSR.exe

Sound card accuracy is critical for some modes (MFSK16, MT63). Olivia and PSK31 are quite robust. The difference between your sound card transmit and receive accuracy is measured in parts per million (PPM) based on a given sample rate. If there is a discrepancy between your tx and rx sample rate, you may not successfully decode or be decoded.

CheckSR is a free program that calculates your sound card error. Run the CheckSR application after confirming your sound-card NATIVE sample rate (FLDIGI/HELP/Audio Device Info/ Default Sample Rate) or use the FLDIGI Configure menu/ Sound Cards/ Sample Rate/ look for Native in the drop down list). Enter the native rate in the CheckSR box, then let the program run for about 3 minutes, then click stop and record the numbers. More time is not necessary or desirable.

Almost all of the software has a configuration setting for entering in the numbers from CheckSR. Many other programs such as MultiPSK, or MMSSTV have built in applications that will make the adjustments automatically.


Sound card sample rate checker ver. 1.0

Sound card settings

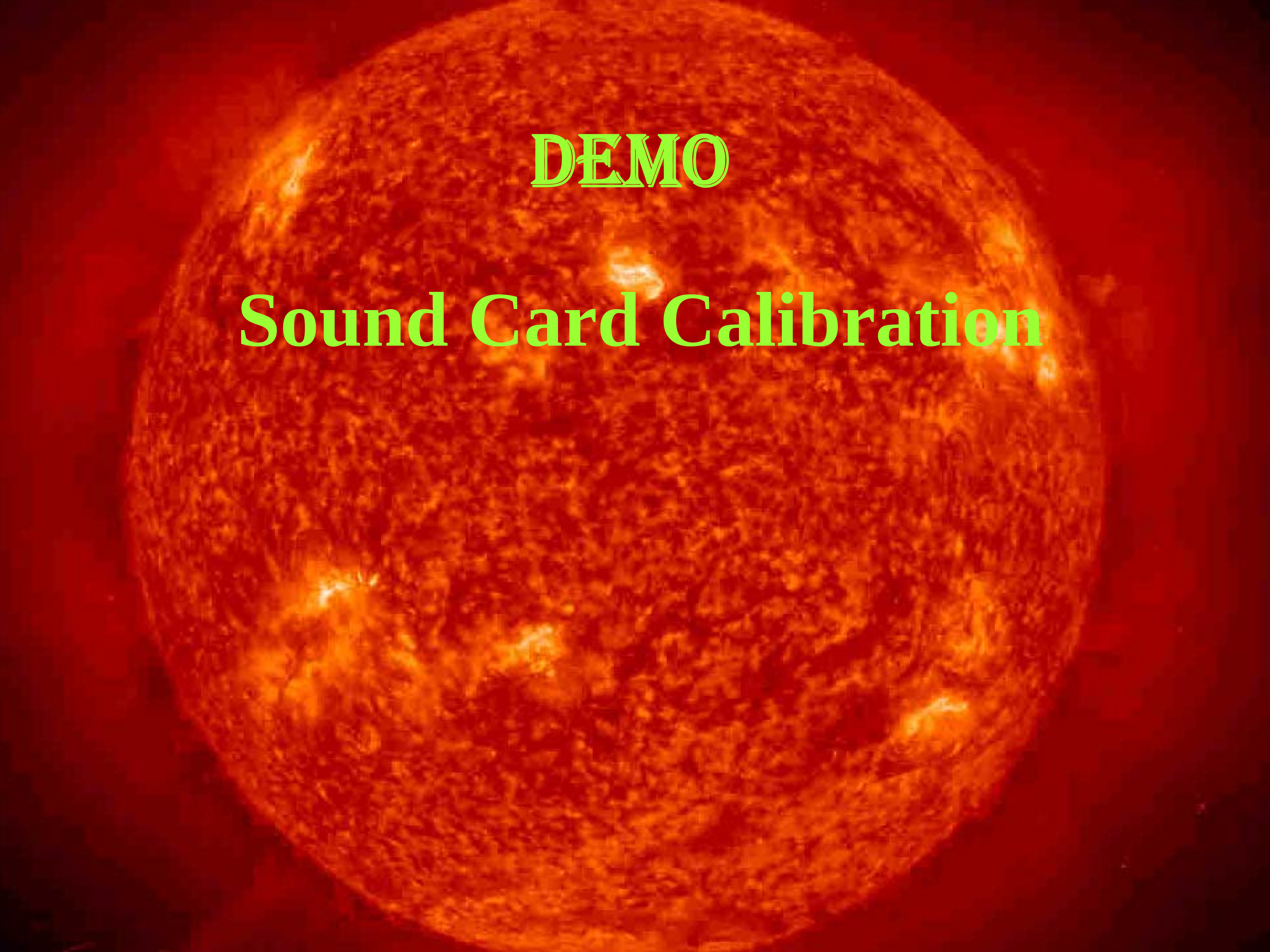
Input: USB Audio CODEC

Output: USB Audio CODEC

Sample rate, Hz: 11025

Measured sample rate - wait for the data to stabilize

	Input:	Output:
Sample rate, Hz:	11066.75	11104.40
Difference, ppm	3786	7201



DEMO

Sound Card Calibration

What is Digital? Component 1 of 2:

“…a mode made to be generated by and decoded by machine – not typically intended to be decoded by human ear…”

CW? Originally was intended to be machine or visually read, but early operators found they could copy the messages from the sounds of the equipment – so now it is by ear with practice.

When you get to the 500, or 800 word per minute rates of CW used for meteor scatter work , it is only readable by machine.

Just for fun: CW is a three symbol code with source coding (variable length alphabet, like varicode) with soft decision coding, and mild FEC (operators interpretation of the code based on S/N) and some convolutional coding with soft decisions (matching characters received against known patterns / words.

If they are meant to be decoded by machine what do you need to do the decoding?

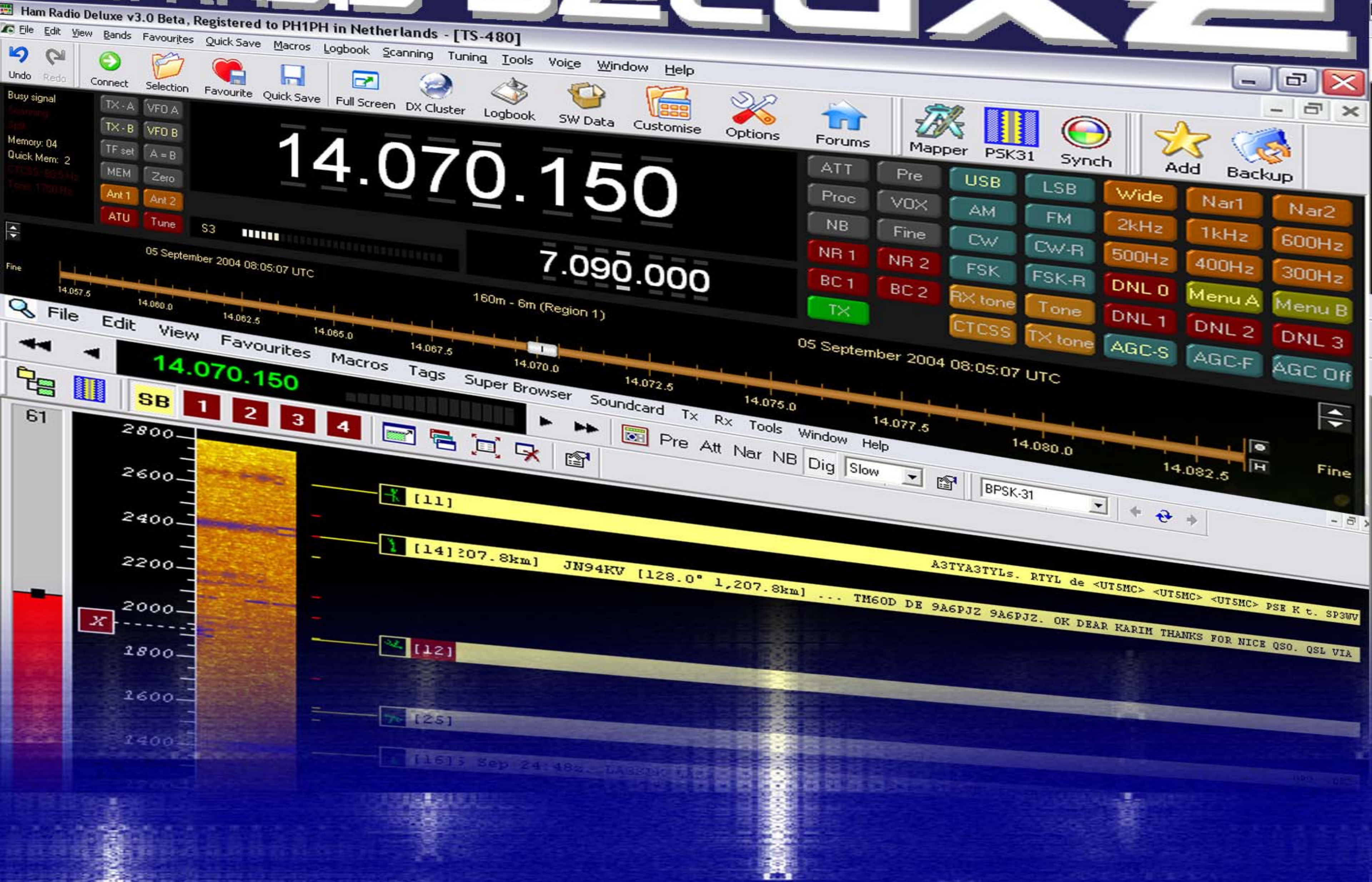
Several Very Popular Packages…

MULTIPSK by Patrick Lindecker, F6CTE – and his (English language) website at http://f6cte.free.fr/index_anglais.htm for MultiPSK 4.14 and a listing of the incredible range of modes supported.

Ham Radio Deluxe (HRD) with the companion program DM780 for the digital modes by Simon Brown, HB9DRVat http://www.ham-radio-deluxe.com/ and the companion digital mode decoding package, DM780 is at
http://www.ham-radio-deluxe.com/Programs/DigitalMaster780/tabid/89/Default.aspx

MixW has a long history http://www.mixw.net/ . and requires a $50 payment and help files available from http://k6ix.net/MixW.html

HAM RADIO DELUXE


Ham Radio Deluxe v3.0 Beta, Registered to PH1PH in Netherlands - [TS-480]
File Edit View Bands Favourites Quick Save Macros Logbook Scanning Tuning Tools Voice Window Help
Undo Redo Connect Selection Favourite Quick Save Full Screen DX Cluster Logbook SW Data Customise Options Forums Mapper PSK31 Synch Add Backup
Busy signal
Memory: 04
Quick Mem: 2
TX - A VFO A TX - B VFO B TF set A = B MEM Zero Ant 1 Ant 2 ATU Tune
14.070.150
S3
7.090.000
05 September 2004 08:05:07 UTC
160m - 6m (Region 1)
ATT Pre Proc VOX NB Fine NR 1 NR 2 BC 1 BC 2 TX
USB LSB AM FM CW CW-R FSK FSK-R RX tone Tone CTCSS TX tone
Wide Nar1 Nar2 2kHz 1kHz 600Hz 500Hz 400Hz 300Hz DNL 0 Menu A Menu B DNL 1 DNL 2 DNL 3 AGC-S AGC-F AGC Off
Fine
14.057.5 14.060.0 14.062.5 14.065.0 14.067.5 14.070.0 14.072.5 14.075.0 14.077.5 14.080.0 14.082.5
File Edit View Favourites Macros Tags Super Browser Soundcard Tx Rx Tools Window Help
14.070.150
SB 1 2 3 4
Pre Att Nar NB Dig Slow BPSK-31
61
2800 2600 2400 2200 2000 1800 1600 1400
[11]
[14]
[12]
[25]
[16]

[14]?07.8km] JN94KV [128.0° 1,207.8km] ... TM60D DE 9A6PJZ 9A6PJZ. OK DEAR KARIM THANKS FOR NICE QSO. QSL VIA

A3TYA3TYLs. RTYL de <UT5MC> <UT5MC> <UT5MC> PSE K t. SP3WV

SIMON BROWN - HB9DRV

PETER HALPIN - PH1PH

NBEMS Suite - Free & Highly Recommended…

NBEMS :   Narrow Band Emergency Messaging System

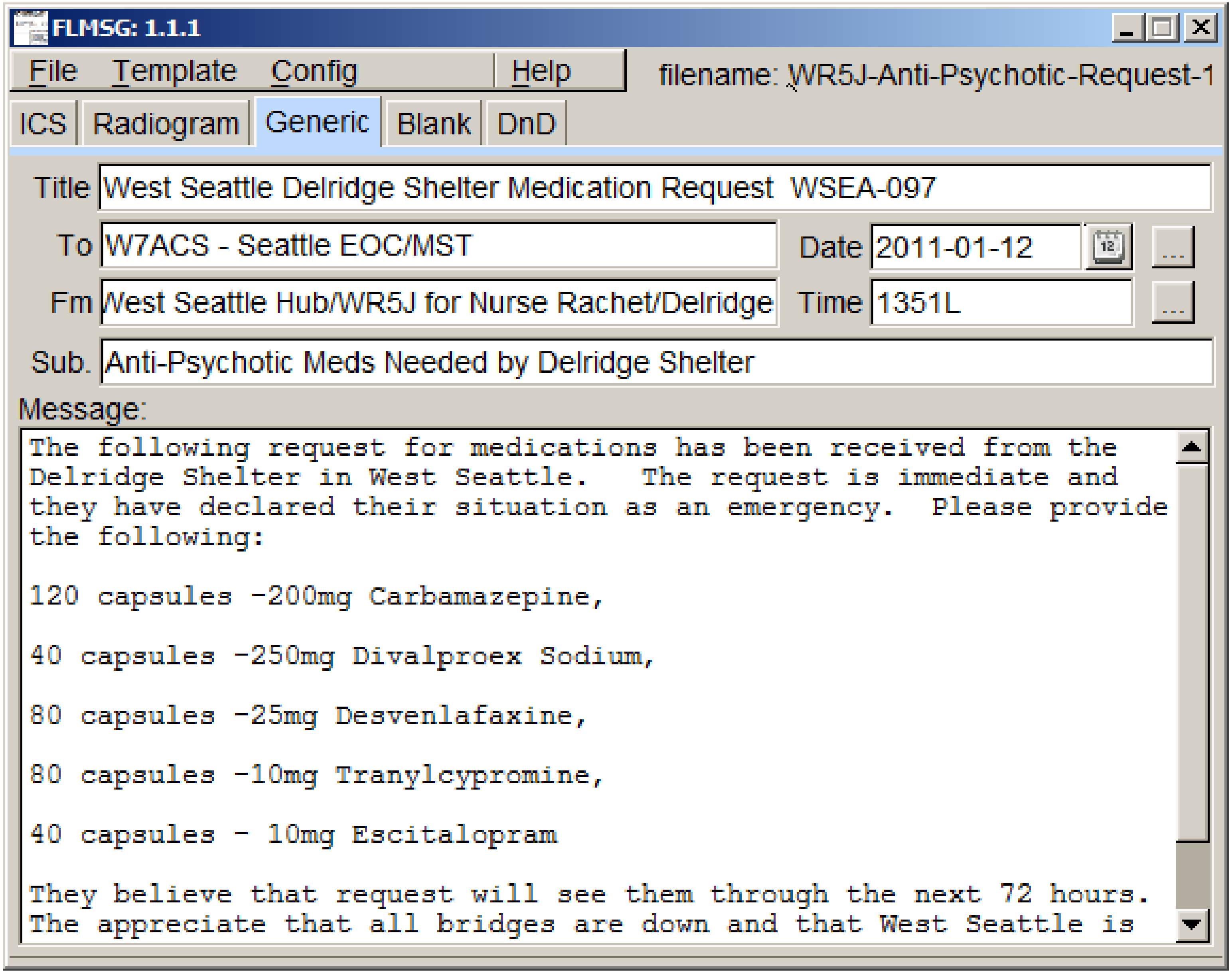
This elegant package is great for quickly getting up and running on digital modes.

Free for downloading from http://www.w1hkj.com/Downloads.html with OSX (APPLE) versions, Linux versions, and versions for Windows 2000, XP and Windows 7.

NBEMS includes FLDIGI, FLWRAP, FLMSG. A Pennsylvania Radio Amateur Emergency group has assembled instructions for downloading, installing, configuring, calibrating, operating and enhancing the NBEMS software. Find them at http://panbems.org/ and follow their sequence.

Also: boot from the thumbdrive with Puppy Linux – bypass the installed OS and be on the air in minutes with acoustic coupling – the ultimate in emergency flexibility.

Why is Digital Better in Emergencies?



filename: WR5J-Anti-Psychotic-Request-1

Title: West Seattle Delridge Shelter Medication Request WSEA-097

To: W7ACS - Seattle EOC/MST

Date: 2011-01-12

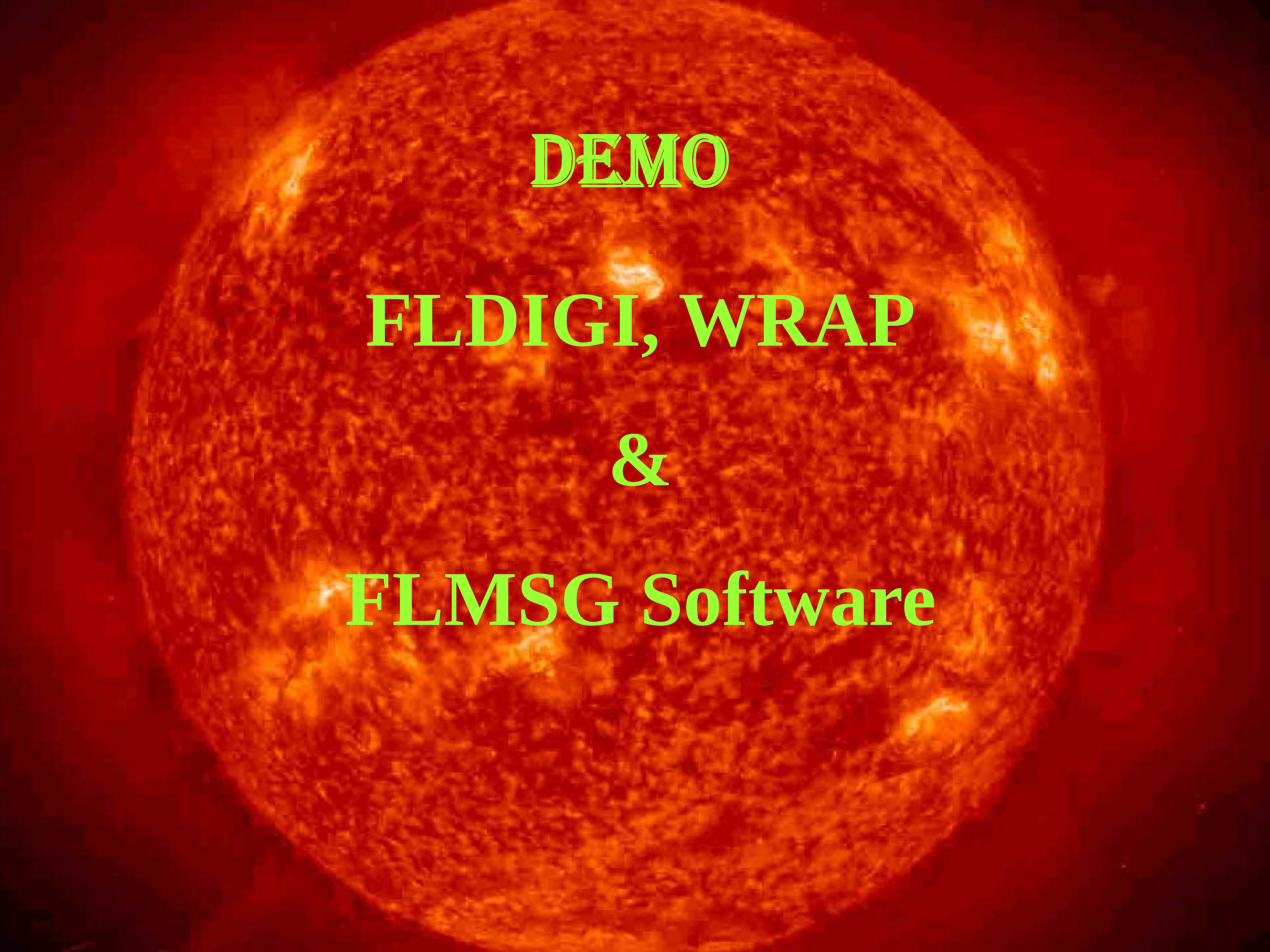
Fm: West Seattle Hub/WR5J for Nurse Rachet/Delridge

Time: 1351L

Sub.: Anti-Psychotic Meds Needed by Delridge Shelter

Message:

```
The following request for medications has been received from the
Delridge Shelter in West Seattle.   The request is immediate and
they have declared their situation as an emergency.  Please provide
the following:

120 capsules -200mg Carbamazepine,

40 capsules -250mg Divalproex Sodium,

80 capsules -25mg Desvenlafaxine,

80 capsules -10mg Tranylcypromine,

40 capsules - 10mg Escitalopram

They believe that request will see them through the next 72 hours.
The appreciate that all bridges are down and that West Seattle is
```



DEMO

FLDIGI, WRAP
&
FLMSG Software

What is Digital? Component 2 of 2:

"…Modes using "digital computers" with bits, Bytes, Analog to Digital (A to D) and Digital to Analog (D to A) conversion, detection and decoding and encoding and synthesis of our transmitted signal…"

Which brings us to Modems and detection and in-phase and quadrature-phase signals and all manner of things that go wrong with signals
And the way we make all this work – which is largely the use of the Discrete Fourier Transform (DFT) and its most amazing form, the
Fast Fourier Transform (FFT)

Digital Signal Processing Cornerstone…
The Fourier Transform

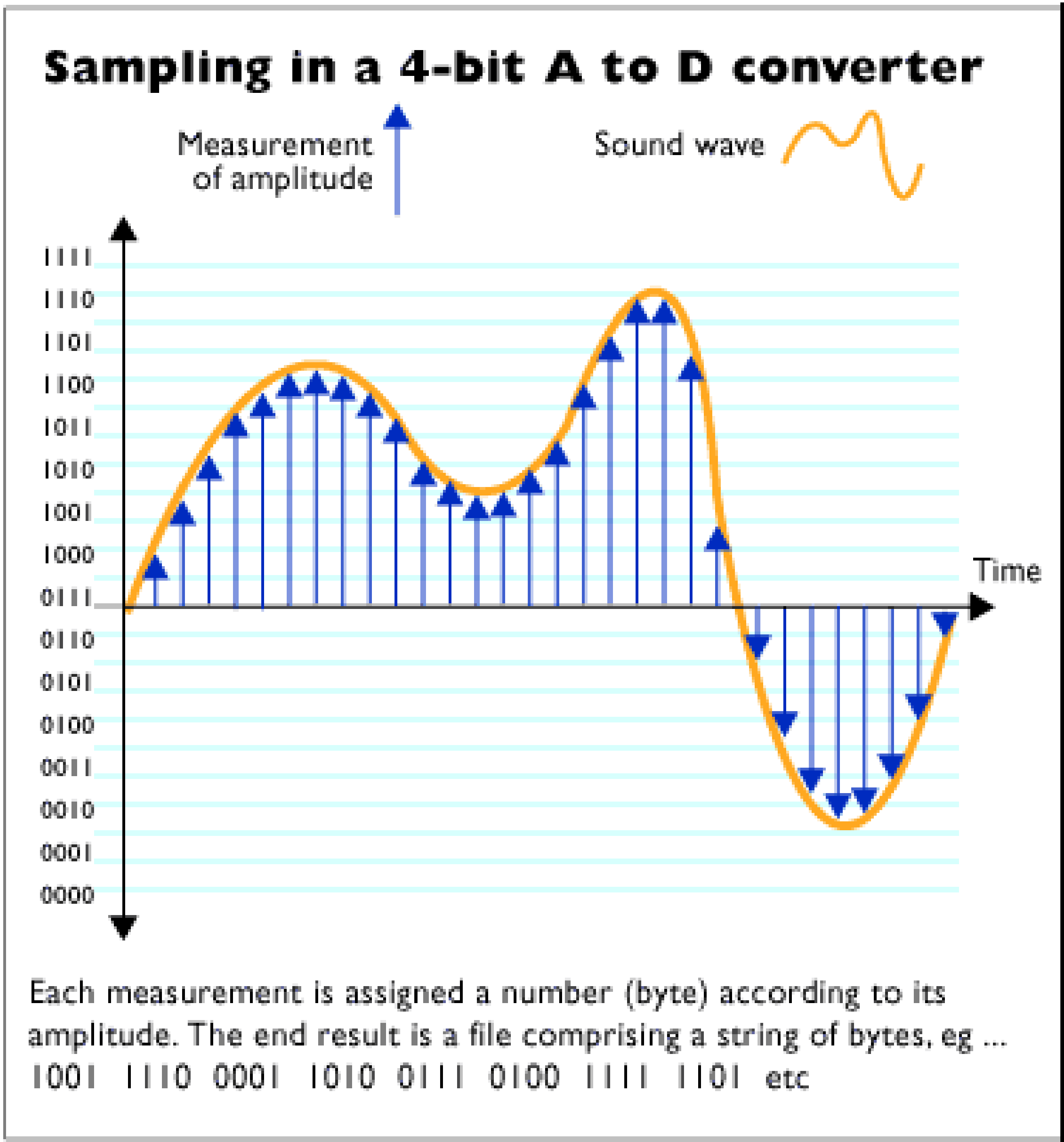
- **Just who was Joe Fourier anyway?**
- **A French mathematician and physicist 1768-1830 that showed any periodic function could be represented by a sum of harmonically related sine and cosine waves.**

$$\hat{f}(n/T) = c_n = \int_{-T/2}^{T/2} e^{-2\pi i n x/T} f(x)\,dx$$

http://en.wikipedia.org/wiki/Fourier_transform

Joseph Fourier

Jean Baptiste Joseph Fourier



Sampling in a 4-bit A to D converter

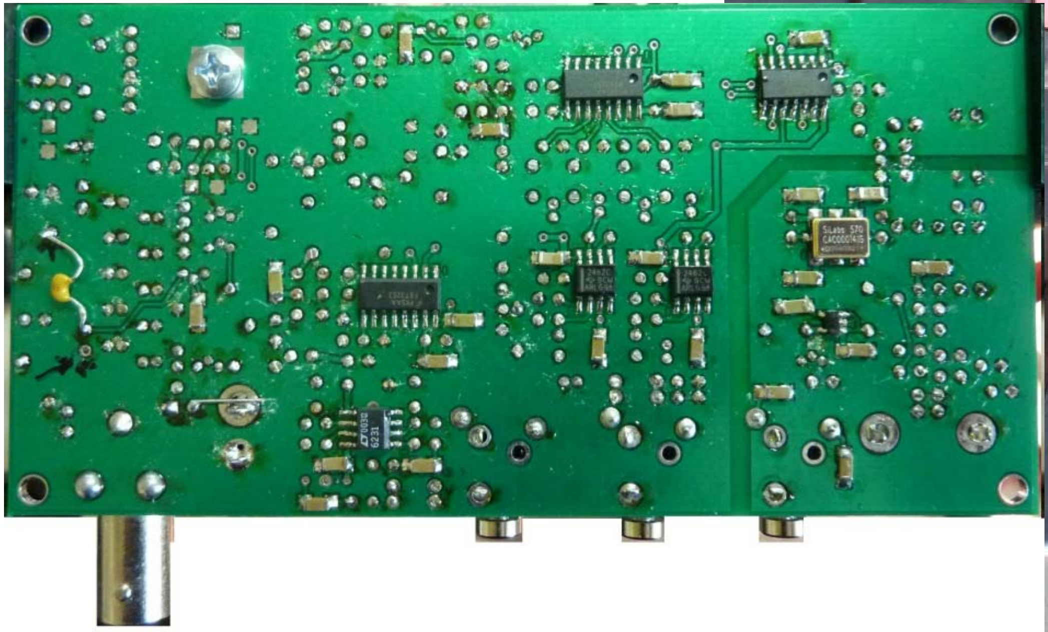
Each measurement is assigned a number (byte) according to its amplitude. The end result is a file comprising a string of bytes, eg ...
1001 1110 0001 1010 0111 0100 1111 1101 etc

Bits	Levels
1	2
2	4
3	8
4	**16**
5	32
6	64
7	128
8	**256**
9	512
10	1024
11	2048
12	4096
13	8192
14	16384
15	32768
16	**65,536**
17	131072
18	262144
19	524288
20	1048576
21	2097152
22	4194304
24	8388601
24	**16,777,21**

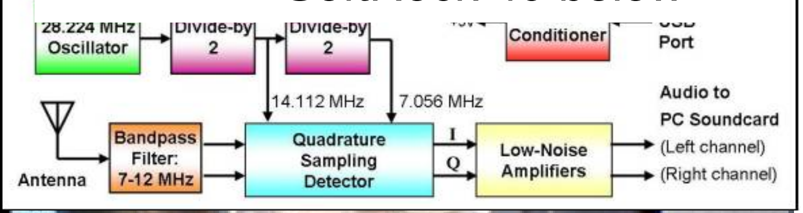
Software Defined Radio - SDR

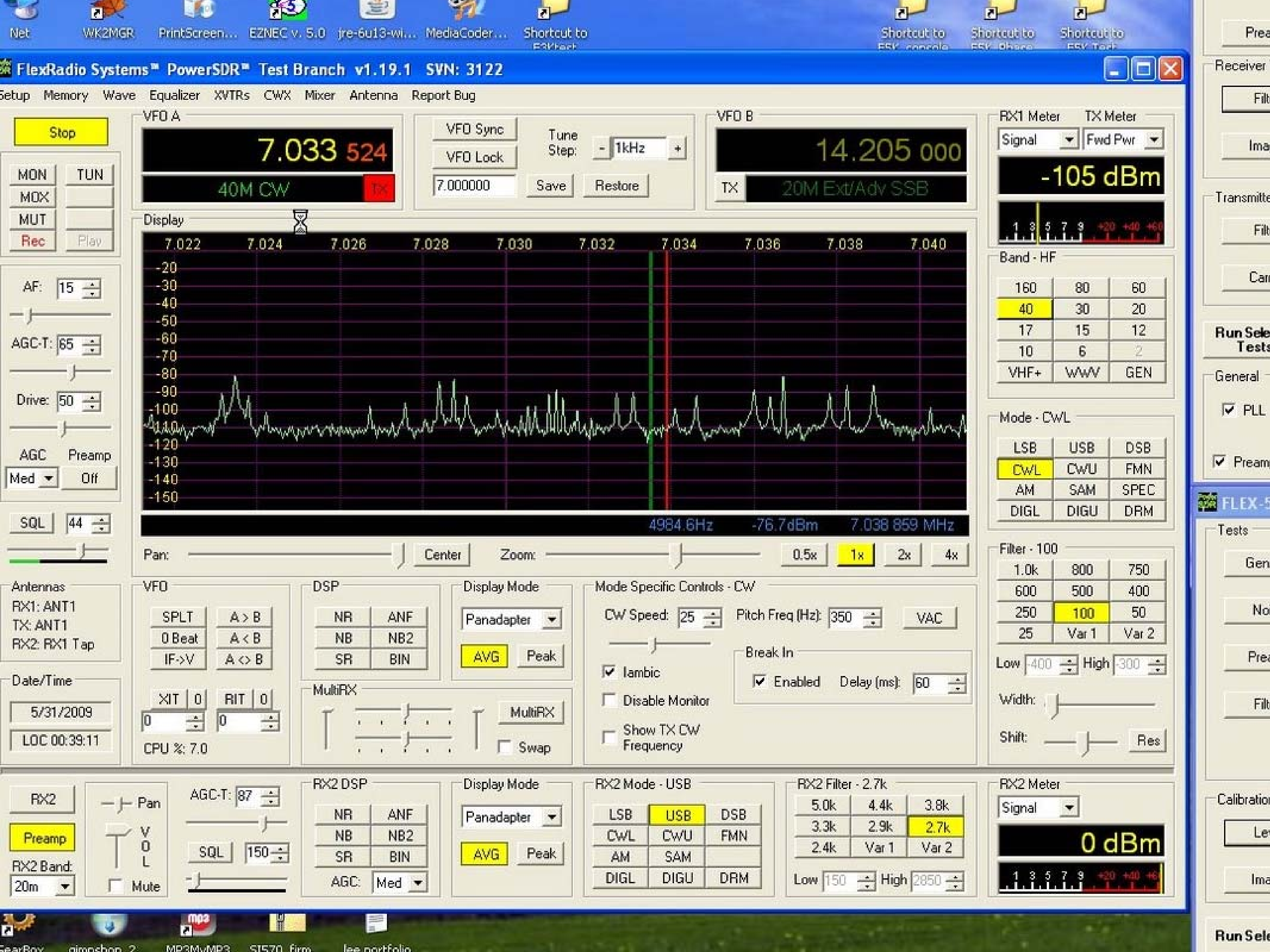
Ensemble RX/TX by

Tony Parks KB9YIG



SoftRock 40 below





FlexRadio Systems™ PowerSDR™ Test Branch v1.19.1 SVN: 3122

VFO A: 7.033 524 — 40M CW

Tune Step: 1kHz

7.000000

VFO B: 14.205 000 — 20M Ext/Adv SSB

RX1 Meter: Signal

TX Meter: Fwd Pwr

-105 dBm

AF: 15

AGC-T: 65

Drive: 50

AGC: Med

Preamp: Off

SQL: 44

Antennas
RX1: ANT1
TX: ANT1
RX2: RX1 Tap

Date/Time
5/31/2009
LOC 00:39:11

XIT: 0

RIT: 0

CPU %: 7.0

4984.6Hz -76.7dBm 7.038 859 MHz

Band - HF: 40

Mode - CWL

Filter - 100

Low: -400 High: -300

Display Mode: Panadapter

Mode Specific Controls - CW

CW Speed: 25

Pitch Freq (Hz): 350

☑ Iambic

☐ Disable Monitor

☐ Show TX CW Frequency

Break In
☑ Enabled
Delay (ms): 60

☐ Swap

AGC-T: 87

SQL: 150

RX2 Band: 20m

☐ Mute

RX2 DSP AGC: Med

Display Mode: Panadapter

RX2 Mode - USB

RX2 Filter - 2.7k

Low: 150 High: 2850

RX2 Meter: Signal

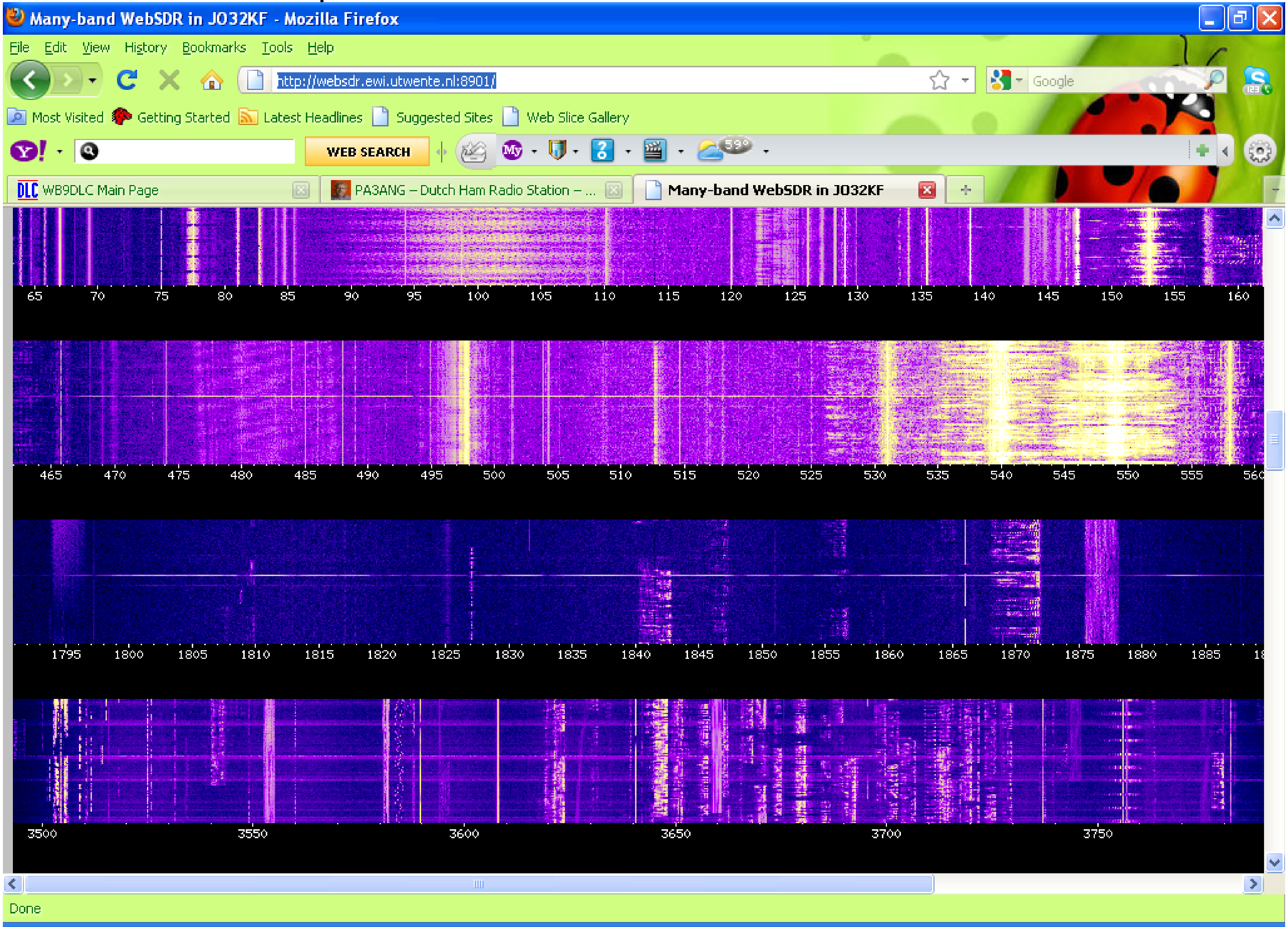
0 dBm

☑ PLL

☑ Preamp

Internet Remote Radio

http://websdr.ewi.utwente.nl:8901/



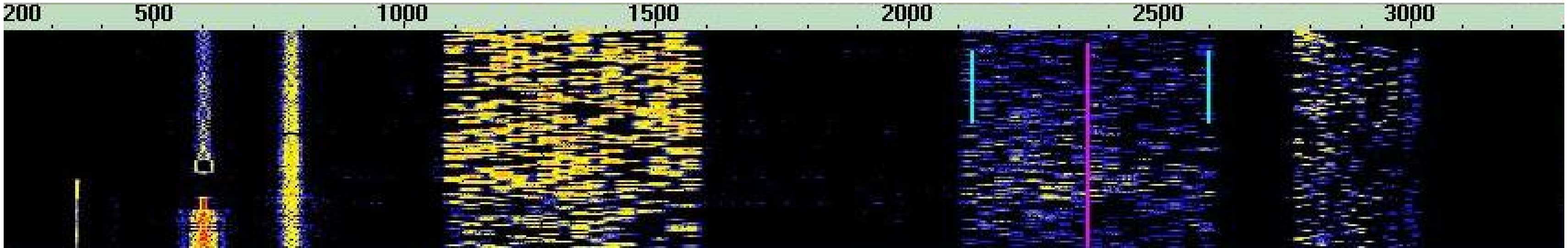
Why is Digital Better in Emergencies?

We already saw you have a 10 to 20 dB advantage over voice (depending on your mode of choice – We train on MT63/2000 for UHF/VHF and MT63/500 or several Olivia Modes for HF).

That is a factor of 10 to 100 which gives us the option of much lower power levels or compromised antennas or other challenges typical of emergency operating conditions.

We also have the ability to generate messages for our served agencies with:

1) Complex Content – Text or Spreadsheets or Images
2) 100% certainty of correct receipt with “WRAP”,
3) “Wrapped” Transmission from One-to-Many
4) Standardized Message Forms beautifully integrated into our software (Work Flow is greatly simplified and standardized).



DEMO

Net Call-UP

and

Macro Editing

How Do I Participate? 1 of 4

Join Puget Sound Digital Hams Yahoo Group

http://tech.groups.yahoo.com/group/P-S-Digi-Hams

(No – don't write that down – just email WR5J@arrl.net

Or radiobug@hotmail.com or seattlemusicguy48@yahoo.com

with your request)

Grab the software from that site's FILES Section or http://panbems.org/

The original location of the software (and best place to get current updates) is:

http://www.w1hkj.com/download.html

Then Join Puget Sound Digital Hams for our weekly nets:
Sundays 4:30pm AJ7JA – 444.375 (203.5 tone)
Mondays 8:00pm WW7SEA – 444.550 (141.3 tone)
Show up with the software running and ready to go…!

Also Join WA-DIGITAL on Yahoo Groups – a great resource!

How Do I Participate? 2 of 4

Then work to incorporate a digital component into every net you participate in.

Practice every week – just a short transmission for folks to test their setup. Shoreline ACS now has 70% participation on their nets. After only 3 months, Seattle ACS got to about 25%.

How Do I Participate? 3 of 4

Then use the digital tools for net content that is well handled by digital (images, spreadsheets, complex information) and use voice for the things that are well handled by voice

How Do I Participate?   4 of 4

Then work on your station: 12 volt power capability for your laptop, a 12 volt bubble-jet or similar printer in your go-kit. Work up standardized digital message forms and procedures which are compatible across the region…

You are done!

^Never

DEMO

EasyPal

Error Free

Image Transmission

(and any file on your computer)

Questions?